No. 626,906. Patented June 13, 1899.

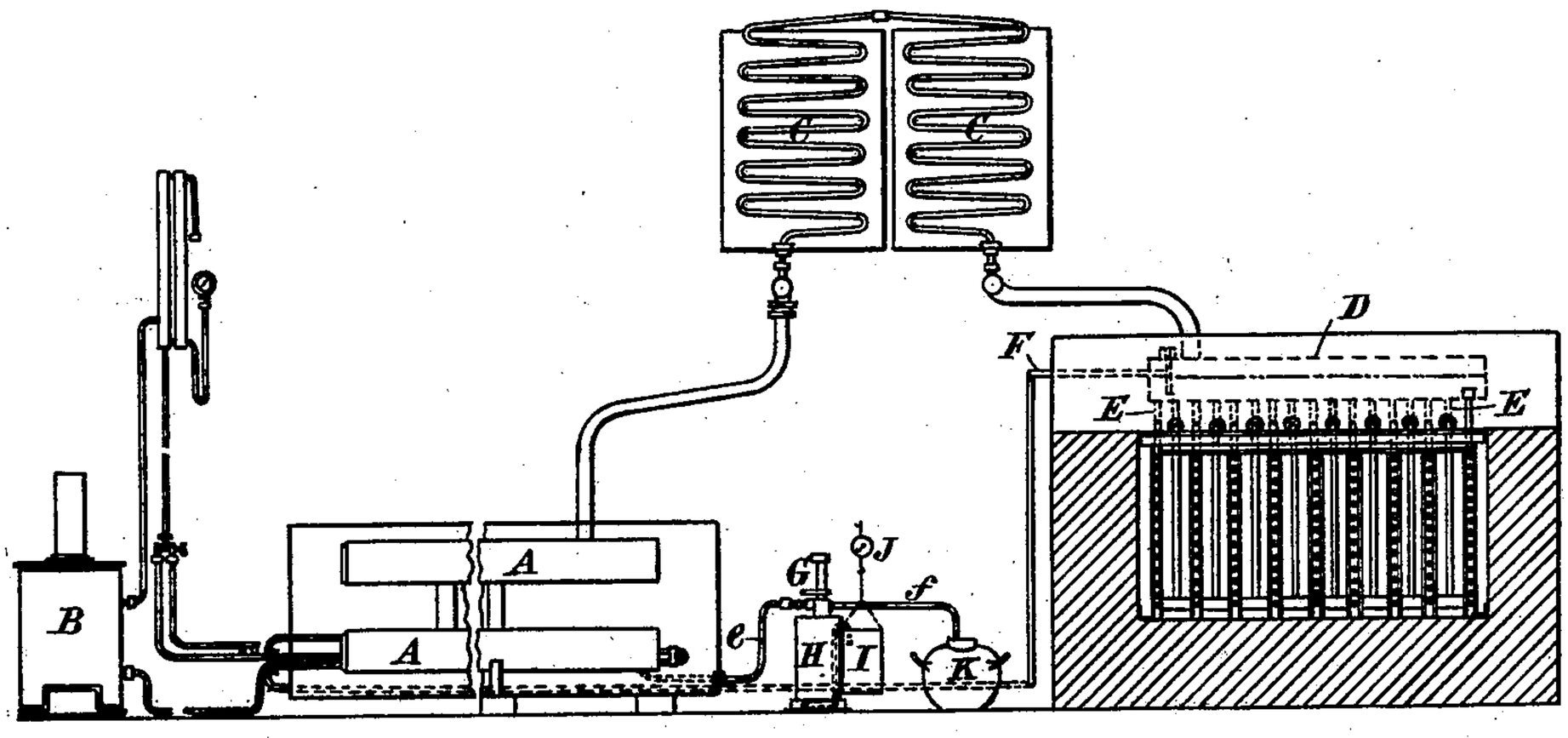
W. W. HARRIS.

REFRIGERATING APPARATUS.

(Application filed Oct. 15, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

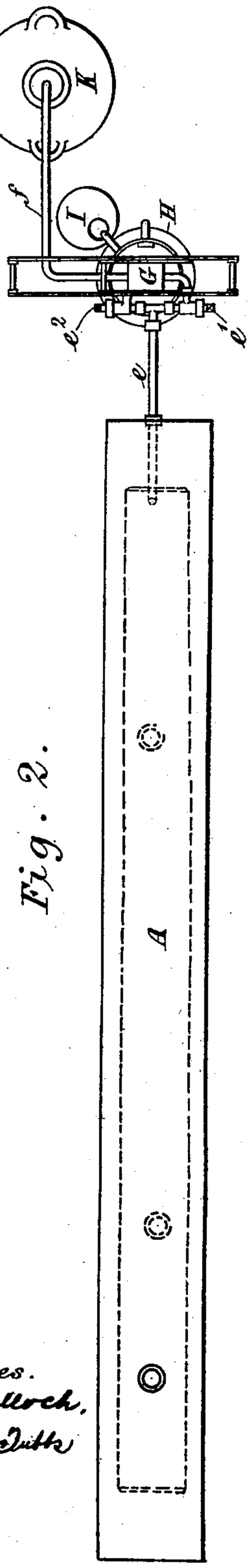

Fig. 2.

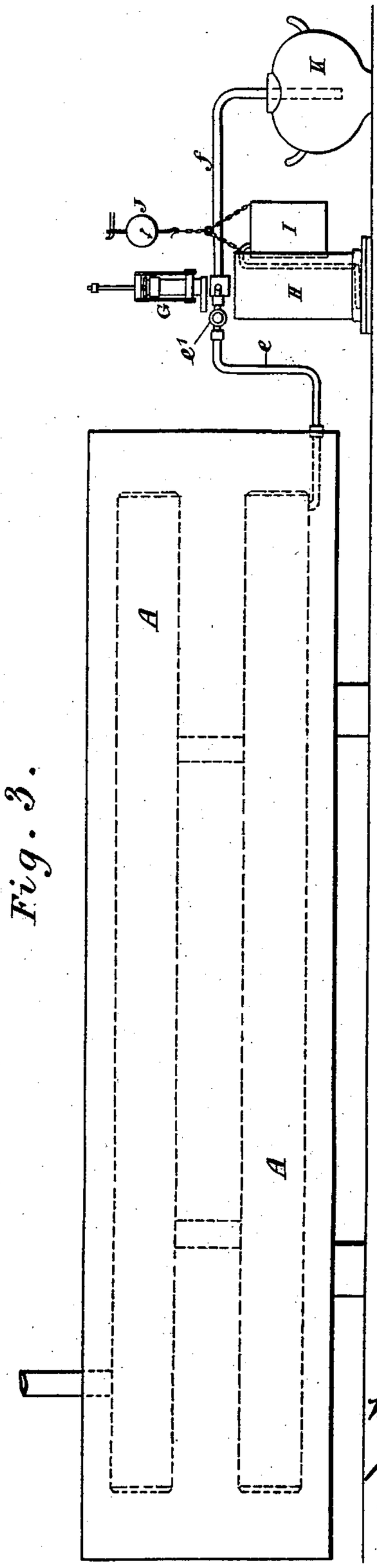

Fig. 3.

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Fig. 4.

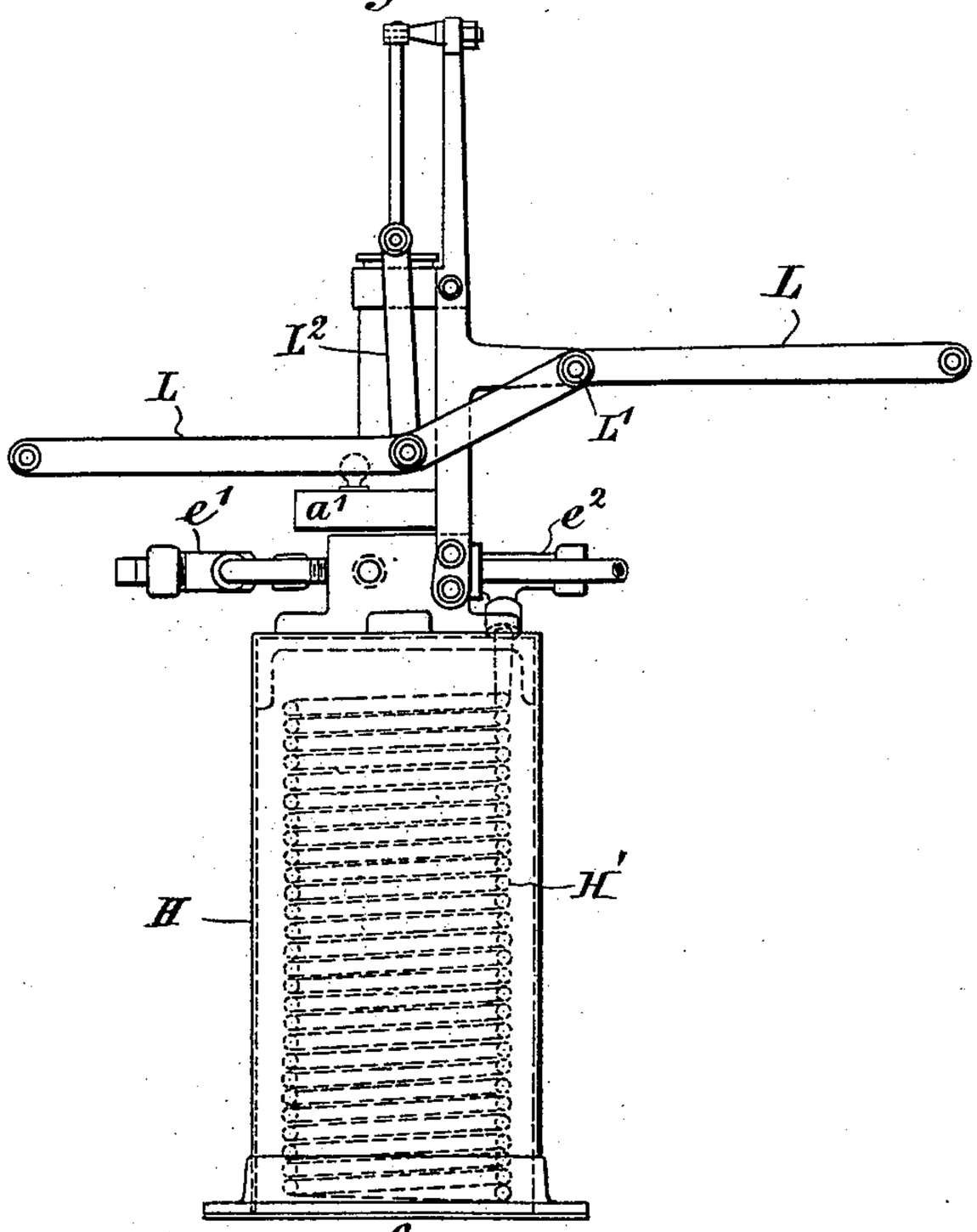
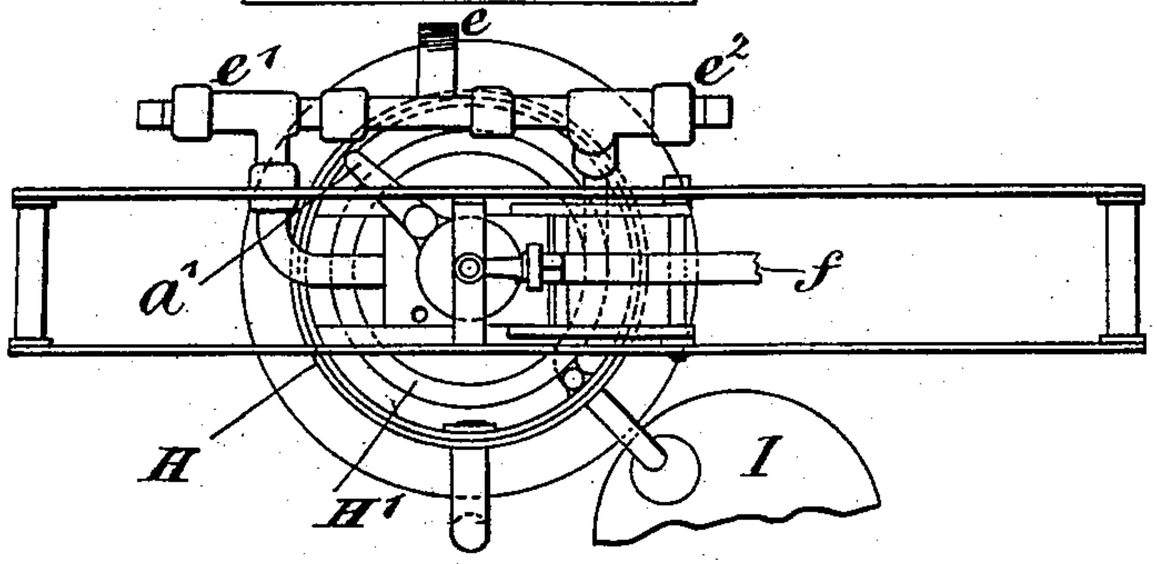


Fig. 5.



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(No Model.) 4 Sheets—Sheet 4.

Fig. 6.

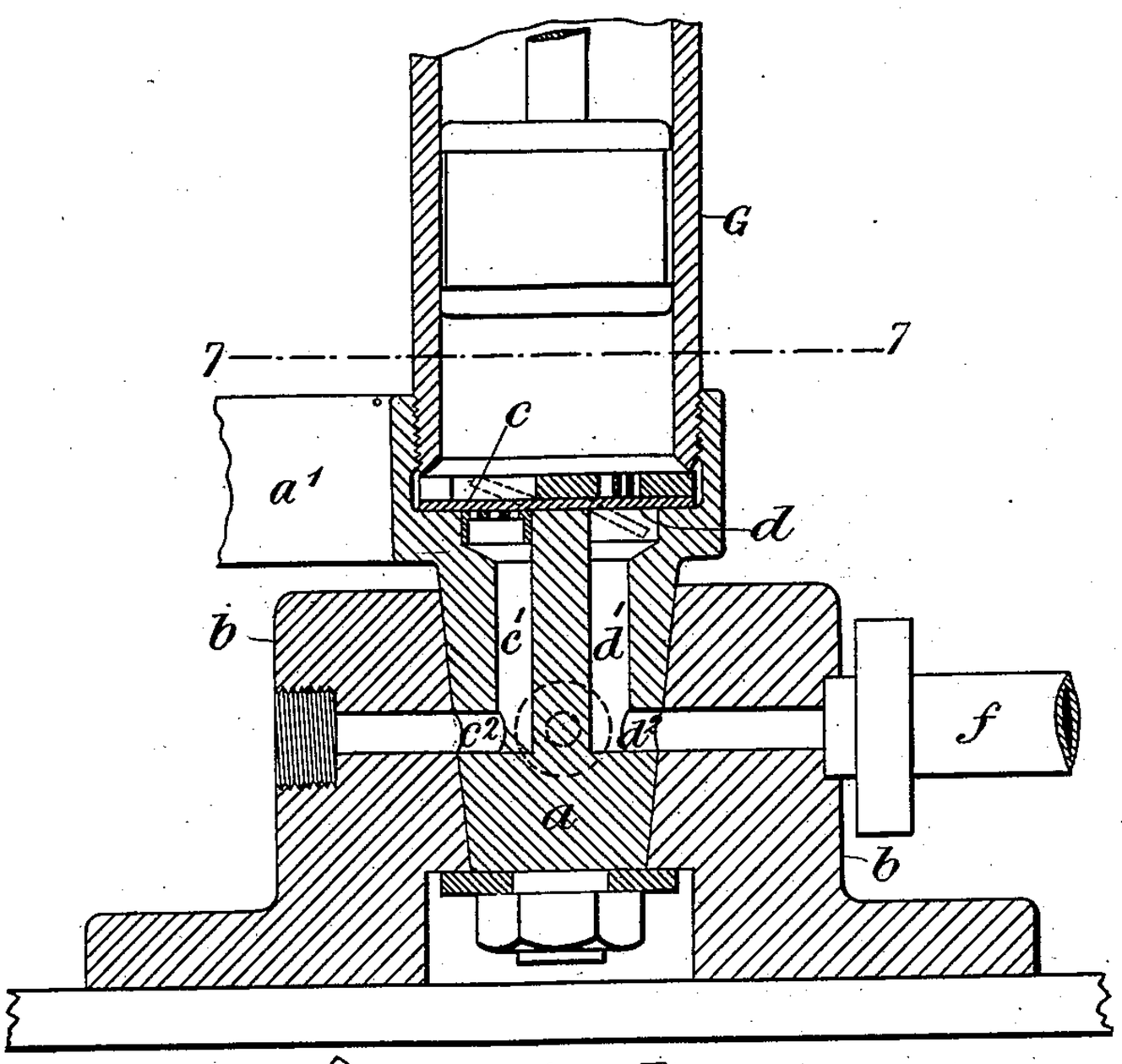
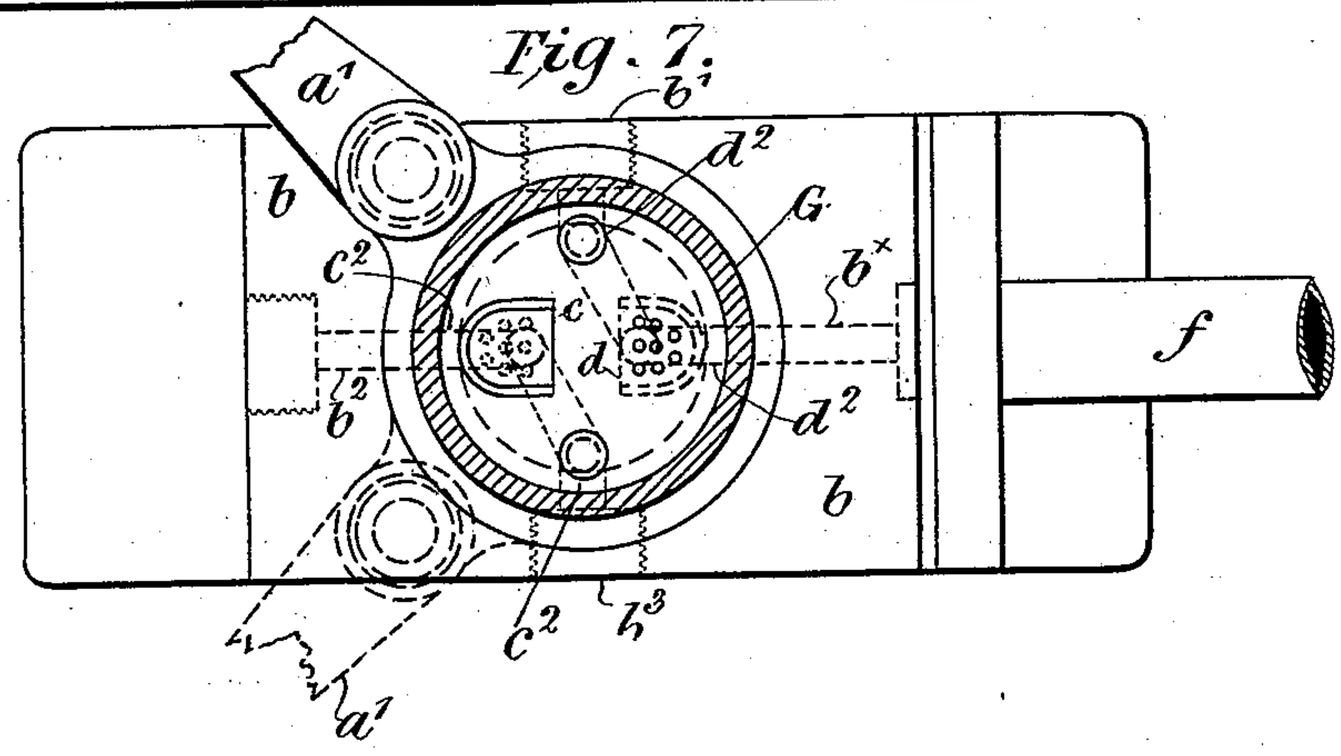


Fig. 7.



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UNITED STATES PATENT OFFICE.

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REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 626,906, dated June 13, 1899.

Application filed October 15, 1898. Serial No. 693,658. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM WALLINGTON HARRIS, engineer, a subject of the Queen of Great Britain, residing at 43 Regent Square, Grays Inn road, London, England, have invented certain new and useful Improved Means and Apparatus Used in the Construction of Refrigerating Apparatus, of which the following is a specification.

The improvements relate to absorption refrigerating apparatus of the kind in which ammonia or other gas is alternately driven off by heat from an evaporator or combiner and collected in a liquid form in a liquefier and afterward, when the evaporator or combiner is cooled and the pressure in the apparatus thereby diminished, evaporates off from the liquefier and is absorbed in water or liquid contained in the evaporator or combiner. In the specification of a former patent, granted to Loftus Perkins on October 28, 1890, No. 439,181, is described such a refrigerating apparatus known as the "Arktos," in which the liquefier, which also serves as a vaporizer, is of a capacity capable of containing a greater quantity of liquid than the quantity of liquefied gas which is collected in it each time that the combiner is heated. In this apparatus the capacity of the liquefier or vaporizer was increased by its being formed with circulating refrigerating-tubes descending from it, and these circulating-tubes were charged with ammonia solution, this solution being used as a vehicle for the transmission of the cooling effect produced by the evaporation of the liquid anhydrous ammonia, with which the main body of the liquefier from time to time became filled. This use of ammonia solution circulating into and out from the liquefier is objectionable for various reasons. By my invention I am enabled to fill the whole of such a liquefier or vaporizer, or a liquefier or vaporizer of other form capable of containing more liquid than the quantity of liquefied ammonia which collects in it each time the combiner is heated, entirely with pure anhydrous liquid ammonia. Therefore when the combiner is allowed to cool the evaporation of liquid anhydrous ammonia will take place much more rapidly than heretofore, as anhydrous ammonia is a much more sensitive medium for absorbing heat than ammonia solution and will absorb heat directly from all parts of the circulating-tubes or other extension of the liquefier. As also the liquefier and refrigerating-pipes or other extension of the liquefier contain a far larger quantity of anhydrous liquid ammonia than the water in the combiner is capable of absorbing, the flow of gas to the combiner will remain constant to the end of each operation, and consequently there will be no feeble period, as heretofore, at the end of each working. The apparatus is therefore rendered much more effective than heretofore, as it can be worked a greater number of times in the same period.

I effect the filling of the liquefier with a larger quantity of pure liquid anhydrous ammonia than passes to the liquefier each time the combiner is heated in the following manner: The interior of the whole of the refrigerating apparatus is first cleared as far as practicable of all air and water which it may contain. Ammonia solution is then delivered by a pump into the combiner, preferably until the combiner contains the quantity of water which it is required always to contain. The combiner is then heated to a temperature of about 270° to 280° Fahrenheit, at which temperature nearly the whole of the ammonia-gas is driven off from the water and the ammonia is collected in a liquefied state in the liquefier, as in the ordinary way of working. A portion of the heated water in the combiner is then drawn off, care being taken to maintain the full temperature of the heated water in the combiner while this is being done. The water as it is drawn off is cooled and collected and then carefully weighed and its temperature and percentage of ammonia noted. A measured quantity of ammonia solution which contains the same amount of water as the amount of water that was drawn off is then by a force-pump forced into the combiner, and the above-described operation is repeated until the circulating-pipes and liquefier have become filled with liquid ammonia up to the level of the overflow from the liquefier. The liquid capacity of the liquefier being known, there is no difficulty in knowing when it will thus have been filled.

Figure 1 of the drawings annexed is a lon-

gitudinal section of an "Arktos" refrigerator having apparatus combined with it whereby the refrigerating-tubes and liquefier can be charged with liquid ammonia in the above manner. Figs. 2 and 3 are respectively a plan and side elevation, on a larger scale, of the combiner and apparatus for withdrawing liquid from and forcing liquid into it. Fig. 4 is a side elevation, and Fig. 5 a plan, of the pumping apparatus. Fig. 6 is a vertical section, on a larger scale, of the lower part of the pump. Fig. 7 is a horizontal section on the line 7 7, Fig. 6.

In the figures, A is the combiner; B, apparatus by which the liquid in the lower part of the combiner can be heated, as described in the above-mentioned patent; C, coils of pipe in which gas passing from the combiner is cooled.

D is the liquefier, in which cooled and liquefied gas is collected.

E are circulating-pipes descending from the lower part of the liquefier.

F is the overflow from the liquefier to the combiner.

G is a pump, and H a tank below the pump, containing a coil of pipe H′, through which water can be drawn off from the combiner and cooled.

I is a vessel in which the water drawn off from the combiner is collected and weighed.

J is a weighing apparatus from which the vessel I is suspended, and K is a vessel containing a supply of ammonia solution.

As will be seen from Figs. 6 and 7, the lower part of the pump-barrel has attached to it a conical plug *a*, received into a conical seat in a fixed block *b*. The plug *a* has a handle *a′* extending from it, by which the plug may have a quarter-turn given to it. At the top of the plug are carried the inlet-valve *c* and the delivery-valve *d*, the valve *c* opening upward and the valve *d* downward. The space below the inlet-valve *c* is connected by a passage *c′* with two ports c^2 at right angles to one another in the side of the plug, and similarly the space below the outlet or delivery valve *d* is connected by a passage *d′* with two ports d^2. In the conical seat *b* are four equidistant ports b' b^2 b^3 b^4. The port b' has a pressure-gage (not shown in the drawings) connected to it. The opposite port b^3 is similarly connected with a vacuum-gage. The port b^2 is connected by a pipe *e* with the lower part of the combiner A, and the opposite port b^4 has a pipe *f* connected to it, the end of which may be inserted into a vessel K containing ammonia solution.

The pipe *e*, which leads from the combiner, is, as shown at Fig. 5, branched at its end, one branch having on it a stop-valve *e′*, being connected with the port b^2 above mentioned, and the other having on it a stop-valve e^2, being connected to the upper end of the coil of pipe H′ in the tank H, above which the pump is mounted. When the stop-cock e^2 is opened and *e′* closed, water can pass out from the combiner through the coil of pipe H′ and be collected in the vessel I, in which the amount so drawn off is to be weighed. When the stop-cock *e′* is opened and e^2 closed and the handle *a′* on the plug *a* is turned into the position shown by full lines in Fig. 7, the pump can be used for exhausting air and water from the combiner and other parts of the refrigerating apparatus, and when the handle *a′* has a quarter-turn given to it and is turned into the position shown by dotted lines the pump can be used for drawing ammonia solution from the vessel K and forcing it into the combiner.

L is a lever pivoted at L′, by which a reciprocating to-and-fro movement can be given to the pump-piston.

L^2 is a link passing from the lever to the piston-rod.

To charge the refrigerating apparatus with ammonia, the stop-cock *e′* is opened and e^2 closed until all air has been exhausted as far as practicable from the interior of the apparatus. A quarter-turn is then given to the pump-barrel, so that when the pump is again worked it will draw ammonia solution from the vessel K and force it into the combiner. When the combiner has in this way been filled with the required quantity of ammonia solution, the stop-cock *e′* is closed and the combiner is heated until the liquid contained in it has been heated up to about 280° Fahrenheit. When this has been done, the liquid in the combiner will be nearly pure water. The stop-cock e^2 is now opened, so allowing water to pass from the combiner through the cooling-coil and into the vessel I. When any desired weight of liquid, as indicated by the weighing mechanism J, has so been drawn off from the combiner, the stop-cock e^2 is closed and *e′* opened. The pump is then again worked to force into the combiner such a quantity of ammonia solution as contains an amount of water equal to that previously drawn off from the combiner and the solution so introduced is heated, as before, up to about 280° Fahrenheit, and this is again and again repeated until the liquefier is filled up to its overflow with liquid ammonia and the combiner with water.

I do not herein claim the pump shown particularly in Figs. 6 and 7 of the drawings, as this subject-matter is claimed in my application filed April 26, 1899, Serial No. 714,538.

What I claim is—

1. An intermittently-acting absorption refrigerating apparatus, comprising a combiner and a liquefier connected together for the passage of the refrigerant from one to the other, a refrigerant, such as ammonia, so proportioned in the apparatus that the liquefier contains pure anhydrous ammonia, or like gas, in greater quantity than the amount of gas which passes from the combiner to the liquefier each time that the combiner is heated.

2. The hereinbefore-described process for filling the liquefier of absorption apparatus with pure liquefied anhydrous ammonia or

like gas in greater quantity than the amount of gas which passes from the combiner to the liquefier each time the combiner is heated such process consisting in first withdrawing as far as practicable all air and liquid from the interior of the apparatus then introducing a charge of ammonia solution into the combiner and heating it therein until all ammonia or nearly so has been driven off from it—then drawing off cooling and collecting a quantity of water from the combiner and subsequently forcing into the combiner a quantity of ammonia solution containing as much water as was previously drawn off from it and when the solution so introduced has been heated sufficiently for all or nearly all the ammonia-gas it contained to be driven off from it again drawing off a quantity of water from the combiner and repeating this operation until the required amount of pure liquefied anhydrous ammonia has been collected in the liquefier.

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